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NATURAL HISTORY OF THE PRAIRIE DOG

IN KANSAS

RONALD E. SMITH

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University of Kansas
Museum of Natural History
and
State Biological Survey of Kansas

EDITOR: E. RAYMOND HALL

Miscellaneous Publication No. 49, pp. 1-39, plates 1-4, figures 1-10
Published September 27, 1967

[Pages 1-36 are reprinted, by the offset process, from Miscellaneous Publication No. 16 of the Museum series. Addenda by Stephen R. Wylie appear on pages 38-39.—Editor.]

PRINTED BY
ROBERT R. (BOB) SANDERS, STATE PRINTER
TOPEKA, KANSAS
1967

31-9493

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By Ronald E. Smith

Museum of Natural History and State Biological Survey
University of Kansas

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Miscellaneous Publication No. 16, pp. 1-36, plates 1-4, figures 1-9

Published June 17, 1958

PRINTED IN
THE STATE PRINTING PLANT
TOPEKA, KANSAS
1958

27-2178

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NATURAL HISTORY OF THE PRAIRIE DOG IN KANSAS

INTRODUCTION

THE prairie dog has lived on the Great Plains of the United States since Pleistocene times. To the Indians he was important as a source of food, especially when large game was scarce. In the middle 1800's, when explorers, trappers, and pioneers crossed the plains west of the Missouri River and east of the Rocky Mountains, the monotony of the long arduous trips was relieved by the antics of the gregarious, small mammal, the prairie dog. Letters and diaries mentioned the animal and frequently contained highly exaggerated accounts of the social structure of prairie dog colonies.

With the settlement of this region and the resulting grazing and cultivation, agriculturists made the prairie dog the object of numerous eradication campaigns, which through the years have brought about marked declines in numbers of the prairie dog.

In 1903, Lantz estimated that prairie dogs inhabited two to two-and-a-half million acres in Kansas, but today they inhabit no more than 57,045 acres and the acreage is being reduced by more than a fourth in the present year (1957). At this rate, within ten years the prairie dog in Kansas will be but a conversation piece in the fascinating tales of "varmit hunting" when Granddad, or Dad, was a little boy. Even though these stories will be interesting, there will be little scientific information or even accuracy in them. Before these animals are even more drastically reduced in number and pushed into yet more isolated and atypical regions of their range, it seemed, to me, worthwhile to undertake the natural history study here reported on of one of the last "large" prairie dog towns in Kansas.

Within limits the prairie dog adapts itself to local conditions; therefore studies in South Dakota or Colorado do not necessarily depict its way of life in Kansas or *vice versa.* Objectives of my study were: (1) To determine the distribution and habitat occupied in Kansas, (2) to study the life history of the species, (3) to determine the economic bearing of the prairie dog's activities on enterprises of man, and (4) to discover factors limiting dispersal and occupation of new habitats.

My field study was begun in June, 1955, and terminated in June, 1957. The area chosen was a pasture five miles north, and one and one-half miles east of Sharon, Barber County, Kansas, on the Hawkins Ranch. To my knowledge this pasture contains the most easterly "large" (more than 40 acres) prairie dog town in Kansas. This area is of the chestnut soil type and has an average annual rainfall of 25.5 inches.

HISTORY

The prairie dog was first brought to the attention of zoologists by a skin obtained by Lewis and Clark on their expedition of 1804-1806, although Pike, 1806-1807, was the first to describe the animal in Kansas and designated it by its Indian name, Wishtonwish. In 1815, George Ord described the animal and named it the Louisiana marmot, *Arctomys ludovicianus.* In 1817, Rafinesque proposed for it the new generic name *Cynomys.* Confusion concerning these names and their correct application existed until the publication of Baird's "Mammals of North America" in 1858, when two species, one black-tailed and the other white-tailed were recognized. Allen, in his "Monograph of the Sciuridae" in 1877, also recognized two species. In 1916, Ned Hollister published his "A Systematic Account of the Prairie-dogs" in the North American Fauna series (No. 40), in which he divided the genus into two subgenera and seven species and subspecies. Only *Cynomys ludovicianus ludovicianus* occurs in Kansas. The first natural history notes on the prairie dog in Kansas known to me were made by J. R. Mead in the year 1859 (published in 1899) in which he wrote, "Prairie dogs were innumerable. The divide between Saline and Solomon in Ellsworth county and west was a continuous dog town for miles; and, as a considerable portion of this locality was underlaid with horizontal beds of shale or limestone near the surface, it was a mystery where they got water. Not a drop could be found within several miles and none by digging above the rock, and not a particle of dew fell for weeks in the heat of summer. The scant grass was dry enough to burn an hour before sunrise; and I was forced to the conclusion that in this instance nature had constructed an animal capable of living for long periods of time without water. My pen cannot describe the extreme heat and drought which sometimes prevailed on these bare uplands during July and August. . . . The foot of the buffalo was necessary for their existence. As soon as the ground ceased to be tramped hard and the grass and weeds grew they perished."

From 1900 to the present the bulk of the literature concerning prairie dogs is in bulletins of agricultural experiment stations and

concerns destructiveness and control of the prairie dog; however, in 1949, Osborn and Allan published in the magazine Ecology a significant paper entitled "Vegetation Of An Abandoned Prairie-dog Town In Tall Grass Prairie," and in 1955, John A. King published a somewhat different type of study entitled "Social Behavior, Social Organization, And Population Dynamics In A Black-tailed Prairie-dog Town In The Black Hills of South Dakota." C. H. Merriam (1901), Vernon Bailey (1926), and Theo. H. Scheffer (1937) all wrote about habits and habitats of the prairie dog.

"Varmit hunting" or "target practice" has been a Sunday afternoon pastime for more than a hundred years in prairie dog country, and needless to say, if the hunters had been more accurate and the prairie dogs less prolific and less agile, the millions of rounds of ammunition expended in their direction would long ago have placed the prairie dog in the present position of the dodo bird.

ACKNOWLEDGMENTS

Thanks are extended to Dr. E. Raymond Hall, under whose guidance this study was made. Dr. Henry S. Fitch and Dr. Carl Koford advised me on field methods, and Dr. Ronald L. McGregor identified plant specimens. Special thanks are extended to Mr. Ezra Hawkins for permission to study the dogtown on his ranch and for his coöperation in various phases of the investigation. Special thanks are extended also to Mr. Floyd T. Amsden who provided for me a residence conveniently near the study area; he encouraged me to use the facilities of Plum Thicket Farm, adjacent to the lands supporting the prairie dogs. Mr. Jess Crocker, game manager of Plum Thicket Farm, and his son, Robert, gave me greatly appreciated assistance in the field.

Without the monetary support of the State Biological Survey of Kansas, such a study would not have been possible.

METHODS

The study here reported on was based chiefly on observation and live trapping, and was supplemented by laboratory investigations.

Observations were carried on with the aid of binoculars and a 20-power spotting scope. Three blinds were set up and used in regularly observing marked prairie dogs. In addition the prairie dogs became so accustomed to the panel truck that as long as a person stayed inside it, the truck could also be used as a "blind" for making observations.

Several types of traps and snares were tried. Best results were obtained with the 9½ x 9½ x 24 inch live traps of the National Live

Trap Company of Tomahawk, Wisconsin. They are collapsible and constructed of heavy gauge wire mesh. Frequently two animals were caught in one trap at the same time.

The traps were baited with oats and usually were tied open for two or three days before they were set. In January, February, and March it was not necessary to tie the traps open because natural food was scarce and the prairie dog readily took the bait. Once an animal was caught, marked, and released it soon became a nuisance, some animals having to be released two and three times a day for as long as the traps were in that locale.

Traps were placed around active burrows, generally two traps to a burrow and about three feet from its opening. Only about one acre or less was trapped at a time as it was necessary to concentrate the traps for best results. Captured animals were handled with thick leather gloves, and although the prairie dogs could and did bite through them, rapidly acquired skill in handling the animals soon eliminated this hazard.

Each individual captured was weighed and sexed. Most of the animals captured were marked and returned to the field but a few were sacrificed for more complete examination. A data sheet facilitated the recording of information.

Toe-clipping caused considerable bleeding in some individuals, and this method of marking was abandoned early in favor of branding; branding fluid and a small branding iron (one inch long by one-fourth inch wide) were used. The fur was cut off by means of a pair of hair clippers before the branding fluid was applied. A variety of symbols could be made with the branding iron, and brands on right or left hind quarter or right or left forequarter gave many possibilities for marking without duplication.

In addition animals were marked with dye (Nyazol A, Nyazol Chemical Company) for easy identification with binoculars or scope. The dye seemed not to affect the behavior of unmarked dogs toward marked dogs. In fact, completely dyed, coal-black prairie dogs moved about within the colony without incident and none is known to have been the object of predation.

The burrows observed from blinds Nos. 1 and 2 were mapped, and distinctively marked dogs were related to their respective burrows.

Temperature, wind velocity, and humidity readings were taken three feet from the ground. Light readings were taken at approximately six inches above the ground.

Questionnaires concerning prairie dogs were sent to twenty-one

western county agents; many residents of Barber County were interviewed or volunteered information concerning present dogtowns in the county or on dogtowns of earlier days.

Twenty-three prairie dogs were kept in the animal house on the University of Kansas Campus from January, 1956, to June, 1956, for observation, including study of molt pattern. The animals were transferred to a building used for laboratory work at Plum Thicket Farm in Barber County, Kansas, and remained there until August, 1956.

All photographs are by the author.

DESCRIPTION AND DISTRIBUTION

A thickset, robust, terrestrial, burrowing squirrel; tail short (rarely more than one-fourth of total length), well-haired but flat; ears short, not extending beyond pelage; eyes moderately large, cheek pouches rudimentary; head broad and rounded; molars large and converging posteriorly; legs short, wrist and heel well-furred; a tuft of hair in the center of palm; feet large; claws well-developed, larger on forefeet than on hind feet, five in number on each foot. Mammae eight.

Total length of adults 335-430 mm., hind foot 47-60 mm. excluding claw, weight 650-1050 grams (1⅛-2½ lbs.). Dental formula $\frac{1}{1}; \frac{0}{0}; \frac{2}{1}; \frac{3}{3} = 22$.

Upper parts cinnamon buff, over-hairs black, underparts and face buffy-white or whitish; terminal third of tail black. Two molts per year; winter pelage longer and having more buff and gray than summer pelage.

Prairie dogs are diurnal, herbivorous, gregarious, and are remarkably curious.

The black-tailed prairie dog, *Cynomys ludovicianus,* is found in the Great Plains from extreme southern Canada south to the Mexican border, chiefly in the Upper Sonoran Life-zone but some colonies occur in the Lower Sonoran Life-zone and a few in the Transition Life-zone. See figure 1. A nominal species, *Cynomys mexicanus,* occurs in southeastern Coahuila, Mexico.

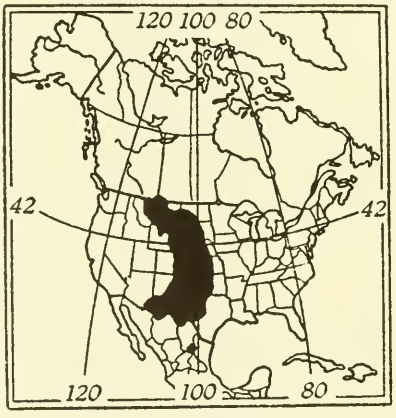

FIG. 1. Distribution of the black-tailed prairie dogs.

FOOD HABITS

Kelso (1939) found that two-thirds to three-fourths of the food was grass. Plants unimportant as forage for livestock comprised about 23 per cent of the food. In general, my findings agreed with his.

The overgrazed pasture where my study was made had as dominant grasses: Blue grama, buffalo grass, foxtail barley, and aristida (both *Aristida longiseta* and *A. purpurascens*). Including annuals, thirty-seven species of plants, as listed immediately below, were fairly common throughout the dogtown.

Taxonomic Name	Vernacular Name
Amaranthus graecizans	white pigweed
Ambrosia psilostachya	western ragweed
Andropogon saccharoides	silver beardgrass
Argemone sp.	white prickly poppy
Aristida longiseta	red three-awn
Aristida purpurascens	arrow feather
Asclepiodora decumbeus	milkweed
Asclepiodora viridis	green milkweed
Baptisia leucophaea	Plains wild indigo
Baptisia minor	wild blue indigo
Bouteloua gracilis	blue grama
Buchloë dactyloides	buffalo grass
Callirhoë alcaeoides	light poppy mallow
Callirhoë involucrata	purple poppy mallow
Chloris verticillata	windmill grass
Croton texensis	Texas croton
Euphorbia marginata	Snow-on-the-mountain
Euphorbia serpens	Spurge
Evolvulus nuttallianus	Nuttall evolvulus
Froelichia floridana	Froelich amaranth
Gaura coccinea	scarlet butterfly weed
Geranium carolinianum	Carolina geranium
Hordeum jubatum	foxtail barley
Lepidium densiflorum	peppergrass
Lippa cuneifolia	frogfruit
Muhlenbergia sp.	wirestem muhly
Opuntia sp.	cactus
Oxalis europaea	yellow wood sorrel
Paspalum ciliatifolium	paspalum
Plantago Purshii	wooly plantain
Plantago virginica	Virginia plantain
Proboscidea louisianica	devil's claw
Schrankia uncinata	sensitive briar
Solanum rostratum	cocklebur
Tradescantia ohiensis	spiderwort
Verbena bracteasta	prostrate vervain
Veronia Baldwini	ironweed

In the later part of June, prairie dogs eat the seed-heads of foxtail barley, grama grass (both heads and leaves), buffalo grass, and cocklebur leaves. Milkweeds are cut but not eaten. All through the summer grasshoppers and a few other insects are eaten, always head first.

In July, grama grass heads, foxtail heads, cocklebur leaves, and around the middle of the month buffalo grass stolons and aristida awns are consumed.

In August, foods are buffalo grass stolons, grama grass, aristida awns and leaves, as well as cocklebur seeds that are shelled from the cockleburs, and seeds and leaves of various low-growing plants found on the mounds, particularly white pig weed, Carolina geranium, spurge, and yellow wood-sorrel.

In autumn and winter, dry buffalo grass, grama grass, and aristida grass comprise the main part of the diet. In December occasional clumps of cactus (*Opuntia* sp.) were eaten. In January, February, and March considerable digging for roots of grasses and forbs takes place (see plate 1, fig. 1). This was especially evident in the early months of 1957 when a prolonged dry spell and overgrazing had reduced the vegetational cover to almost nothing. Certain areas, especially those supporting stands of *Andropogon,* were so dug up as to give the appearance of having been cultivated. Prairie dogs gathered from considerable distances at these places and dug small holes three-and-a-half to four inches in diameter and four to five inches deep. In April considerable quantities of the darkling beetle, *Eleodes hispilabis,* were found around the burrow openings and remains were found also in stomach contents. In the later part of April, May, and early June, peppergrass was consumed in considerable amounts; in some stomachs this annual made up fifty per cent of the contents.

In mid-June of 1955, when my study was begun, grass covered thirty-five to forty per cent of the ground in the dogtown. The grass was cropped short within the dogtown, but was tall at the edge. This tall grass was grama having seed heads ten to fifteen inches high, foxtail barley having seed heads eight to ten inches high, and buffalo stolons eighteen to twenty-four inches long.

Cattle, like other grazing animals, do not graze the range evenly but in "favored" places. The area of this prairie dog town is just such a favored (by cattle) area, as, indeed, are most of the prairie dog towns of Barber County. A windmill stands on the hill at the north edge of the dogtown and there is a pond formed by a dam at the southern edge of the town. Cattle gather at these places, milling about, drinking, grazing, resting, and at the pond finding relief

from the flies by wading into the water. The combination of the 300 head of cattle and native rodents deleteriously affect vegetation and prevent the growth of grass.

As the drouth continued in 1956, some areas of the dogtown were bare and other areas were fifteen per cent covered by vegetation whereas outside the dogtown the vegetation covered twenty-five per cent of the ground. The pond dried up late in June and was completely dry for eight months. In the autumn the cattle were taken off the area. Severe dust storms occurred; wind eroded areas around the pond and windmill. In December of 1956, and in January, February, and March of 1957, the prairie dogs dug for roots until parts of the dogtown looked as though they had been cultivated. April and May brought ten inches of rain, which came in slow drizzles, soaking in with little or no runoff. Annuals, especially peppergrass, began to green up the area and form a dense ground cover. How extensive the damage to the grass had been cannot be determined at this writing.

Since the study by Taylor, Vorhies, and Lister on jackrabbits in 1935, the concept of "animal weeds" set forth by them has been accepted by most ecologists. The concept is that certain animals, like certain plants, increase with the disturbance of the climax and decline as the climax is restored. Data in numerous papers have substantiated the concept but it seems not to be fully understood by many farmers and ranchers, who could make the most use of it.

Even the farmer-rancher group accepts the fact that rabbits and various range rodents are more numerous on depleted and weedy ranges than on ranges of good vegetative cover, but almost without exception wrongly regards these mammals as the "cause" instead of the "result" of range depletion by overgrazing.

Taylor, Vorhies, and Lister set up protected plots next to plots heavily grazed by livestock and separated only by a barbwire stockfence. Grazing pressure from jackrabbits was three times as heavy on the plot grazed by cattle as on the protected plot.

At the Wichita Mountains Wildlife Refuge in Oklahoma, Osborn and Allan recorded an instance where a prairie dog colony was protected and cattle were removed from the area. In spite of the activities of the prairie dogs, the grass cover increased in density and the prairie dogs abandoned the area because it reverted to vegetation unsuitable as a habitat for them!

These findings are supported by observations in Barber County. In 1946, Mr. Floyd T. Amsden acquired a 640-acre section across the road from the pasture in which the dogtown is situated but one mile south of the town. At that time Amsden's land was a badly

eroded, overgrazed area, resembling the rest of northeastern Barber County. From 1946 to 1956 Amsden's land was not grazed but was managed for the production of wildlife. Now (1957), the hills are covered with stands of sand bluestem (*Andropogon hallii*) four to six feet tall and the drouth has had little visible effect on the vegetative cover. Jackrabbits, grasshoppers, and even the thirteen-lined ground squirrel are few compared with the populations just across the road. Since 1950, five different prairie dog towns have been started in overgrazed pastures within a five mile radius of the main dogtown. Mr. Amsden, owner, and Mr. Crocker, game manager, of Plum Thicket Farm have reported three instances of finding prairie dogs on Plum Thicket Farm, but prairie dogs never establish colonies there.

It is obvious from these studies that overgrazing by cattle is primarily responsible for the disappearance of the range grasses. Thus room is made for the annuals and their fleshy roots and larger and more numerous seeds, that constitute an increased food supply. Consequently the prairie dog population increases. In times of drought, prairie dogs may help cattle destroy the range completely. The remedy, of course, is to remove the cattle. Under ordinary conditions, however, herbivorous small mammals may speed up plant succession by their preferential food habits; they eat plant species typical of early successional stages—plants not eaten by cattle. J. R. Mead's observation in 1859, that ". . . the foot of the buffalo was necessary for their [prairie dogs'] existence" and that "As soon as . . . the grass and weeds grew they perished," holds true for the prairie dog-cattle relationship also. Proper management of cattle is the keynote of success in reducing the numbers of prairie dogs on range land.

BEHAVIOR

Communication

The alarm bark is given to indicate animals or objects not necessarily considered dangerous but irritating by their presence, such as a man, cattle, traps, instruments, and vehicles. The prairie dog runs to its mound and crouching over the burrow emits a two-syllable sound—tic-uhl; tic-uhl; tic-uhl—the first syllable of which is of a higher pitch and shorter duration than the second. The bark is accompanied by a vertical flick of the tail; frequently all that can be seen of the prairie dog is its head and tail. The frequency and intensity of this bark is greatest during the first two or three minutes in which it is given; thereafter the frequency slows to around forty

barks per minute (this varies considerably) and may continue for as long as an hour-and-a-half.

On hearing this bark all prairie dogs in the immediate vicinity sit up and look around; if they too are suspicious of this object or animal they run to their mounds and join in the bark. Some prairie dogs, however, utter the alarm call so often that, as in the case of the alpine shepherd boy who called "wolf" too often, associates pay no attention. One old female in the area of blind No. 1 established the one-and-a-half hour record mentioned above. She could not induce the others to look up from their routine activities whenever she instituted the alarm bark. She barked at everything—horned larks, cattle, rabbits, large landlubber grasshoppers, and of course at me.

The predator or hawk warning bark consists of the same two syllables as the alarm bark, but because the second syllable maintains a high pitch the two barks are recognizably different. Individuals do not wait to perceive the danger themselves, as with the alarm bark, but dash for their burrows. Prairie dogs reaching the safety of the burrow entrance may emit the typical alarm bark as long as the predator is near. This predator bark is given in response to soaring birds and the badger. Interestingly, a prairie dog will feed within fifteen to twenty feet of a vulture on the ground, but if the bird is flying and especially if the shadow of the soaring bird passes across the area, then the prairie dog perceives the bird as dangerous and emits the predator bark. A prairie falcon sitting on the ground does alarm the prairie dogs. One windy afternoon a prairie falcon alighted in the dogtown to rest and preen. Its presence evoked considerable commotion; prairie dogs watched it from their mounds and barked excitedly until the falcon left thirty-five minutes later. Badger activity within the dogtown could easily be pin-pointed in early morning or late evening hours by listening for this bark.

An amusing call that is difficult to interpret without anthropomorphizing a bit is the "all clear" call. When it is emitted the prairie dog always throws its forefeet high into the air and brings them down in the manner of a grand salaam—often with such force that the animal falls over backwards or leaps into the air. This also is a two syllable call—ăeeee-ou—, the first syllable being uttered in a high pitch as the forefeet are thrown into the air, and the short, guttural, second syllable is omitted as the forefeet drop to the ground.

This call is heard after danger is past and so is given the "all clear" interpretation, but is repeated again and again on warm, clear, sunny mornings just after the prairie dogs come out of their

burrows. At this time it is "contagious" and goes the rounds of all who are already out. During feeding in late morning this call may be given for no apparent reason, but at this time is not so "contagious" to others and therefore causes an observer to wonder if the call is a greeting. When my pet prairie dog was in the house or yard and did not come when I called, her whereabouts could be determined by my giving an admittedly poor imitation of this call, which was immediately answered by her in true prairie dog style.

Certain prairie dogs seemed to be antagonistic towards thirteen-lined ground squirrels, and before giving chase emitted a low-pitched snarl. The sound was also heard from a few prairie dogs in the laboratory when they were handled.

Tooth chattering consists of gnashing the teeth together rapidly, and is accompanied by occasional low, muffled barks. Animals in the laboratory frequently do this while asleep, and animals in the field have been observed "chattering" while being groomed by another prairie dog. One author had the idea that the chattering is a warning or indication of anger; my observations do not support this idea and suggest that the chattering has many meanings, and possibly sometimes none at all.

A scream is emitted that seems to be a fear reaction. Young prairie dogs being handled for the first time occasionally give this scream; and I heard it one evening when a badger was chasing a prairie dog. The chase ended out of my sight behind an earthen dam. When the scream was given the other dogs watching the chase bolted down their burrows. Although the place was investigated as soon as I could get to it, the badger had disappeared into a hole and no sign of blood was found; therefore, it cannot be assumed that the scream was from a dying animal.

Vocalizations associated with aggressive behavior and defense of territory have been reported by King (1955:73-76). On the Barber County study area in Kansas, aggressiveness and territorial disputes as described by King (*loc. cit.*) for prairie dogs in South Dakota, were so infrequent that I was unable to draw adequate conclusions from them.

Intraspecific Contacts

The mouth contact or "kiss" is effected by one prairie dog turning its head slightly and touching its open mouth (incisors) to that of another prairie dog, after which they may graze together, groom each other, or go in opposite directions. The contact often occurs when a prairie dog is on its mound and another, or others, run to the mound; the first prairie dog "kisses" the others as they arrive.

When prairie dogs are grazing, one may run to another a few feet distant, "kiss," and return to grazing. In one stage of their development, young prairie dogs move about making mouth contact with every prairie dog that they see. Animals in the laboratory frequently behave as though they desired to "kiss." In such instances the desire seems to be satisfied if a person grasps their incisor teeth by means of his fingers. If a prairie dog in nature does not "kiss," the one making the advance frequently raises its tail, spreads it, and snarls; then either a "kiss" results or a chase is on.

Sometimes, a crouching position is assumed by both prairie dogs. Then the first one turns around showing the three anal glands, which the other prairie dog smells. Then the position is reversed and the first prairie dog smells the other prairie dog's anal glands. After all this the two prairie dogs wander off to feed.

Mouth contacts may or may not precede grooming (one prairie dog using its teeth to go over the fur of another). This activity is obviously more than just getting rid of external parasites, and probably creates a pleasant tactile reaction as laboratory animals free of external parasites continue to groom each other. A pet prairie dog is fond of being scratched or even brushed, and in return "grooms" the hair on a person's arm or nibbles at the skin on the hand.

In some animals, grooming is reported to occur according to a hierarchy, thus demonstrating a dominance of certain individuals by others. As for my observations, one animal did not groom any one more frequently than another. The young seem to be fond of being groomed and of grooming, and adults of both sexes indulge the young in this activity.

Prairie dogs seem to enjoy being in close proximity to each other, this often being observed as they sun themselves or gather on the mound. Laboratory animals nestle or huddle together at night. Their sleeping positions are varied but two positions seem to be preferred over others. The position most often observed is a sitting one with the forelegs crossed over the chest and the head bent down between the hind legs giving the appearance of a furry ball. Another highly favored position consists of lying on the back, forelegs crossed over the chest or sometimes all legs relaxed with no definite position assumed and the head resting on the body of another prairie dog.

Laboratory animals frequently bark in their sleep and on occasion it has been necessary to wake my pet prairie dog in order to quiet her. Since 1950, I've had three pet prairie dogs and each so barked. I have spent some time at night listening at burrows but without hearing any sound therefrom.

In early morning, on the sunny side of the mound, when the sun is just high enough to warm the mounds, a prairie dog frequently spends ten to twenty minutes stretched out on its belly, forelegs straight ahead, hind legs straight behind, sunning itself. This sunning is accompanied by much yawning and stretching but the position itself is not changed.

Daily Routine and Feeding Behavior

In July, prairie dogs are above ground by 5:30 A. M., but in January, they rarely come above ground before 10 A. M. to 11 A. M. They spend 10 to 20 minutes after coming above ground sitting on the mound, looking around and greeting (kissing) other prairie dogs as they appear. The prairie dogs then move out to feed and after 30 minutes to an hour return to the mound to stretch out and sun themselves. After the initial feeding, especially in spring and summer, considerable play activity takes place among the young, and the young and the adults.

In summer the heaviest concentration of feeding activity occurs from 7-11 A. M. and 5-8 P. M. Population counts are best made in these hours. They feed at all hours of the day, occasionally going into the burrows to rest, and frequently dashing to the mound in response to the alarm call of another prairie dog or spending 10-15 minutes ascertaining whether an alarm call in another part of the town should be responded to or not. Although prairie dogs wander in the course of feeding, characteristically an hour or two is spent eating buffalo grass stolons or foxtail barley heads, and another hour or two is spent eating grama grass or possibly cocklebur plants. In summer about one-third of the daylight hours are spent in actual feeding, one-third in wandering around, playing, working on mounds and burrows, or responding to alarm calls, and one-fourth to one-third of the daylight hours are spent in the burrow.

At sunset, prairie dogs come in from the outlying areas and feed closer to the mound. They begin to enter the burrow one by one until 15-30 minutes later all are below ground and the dogtown is quiet. This complete silence impresses on an observer how noisy these gregarious creatures really are.

In feeding, a prairie dog cuts vegetation at its base, stands upright with the food in one paw and eats from the basal portion distally. In this way, spiny plants such as the cockelbur can be eaten without injury to the mouth. Frequently only a few bites are taken, the rest is discarded, and a new stalk of grass is cut. While feeding, the prairie dog waddles about in a leisurely manner, but if the predator call should be given, leisure gives way to haste.

Humidity had no noticeable effect on the prairie dogs; of course during rains or snow storms the animals remained in the burrows. See plate 1, fig. 2.

Wind velocity under thirty-five miles per hour had no noticeable effect. Winds of higher velocity almost all were the hot dry winds of July and August and it was difficult to single out either the heat or the high velocity of the wind as the cause of the prairie dogs remaining in their burrows.

Prairie dogs like sunshine and warm weather, but, like many other animals, are unable to tolerate temperatures much higher than 100° F. In June, July, and August of 1955, there were 23 days of 100° F. readings or higher. In July and August of 1956, there were 18 consecutive days of temperatures higher than 100° F.—the highest was 112° F. In these periods the prairie dogs showed no inclination to aestivate but concentrated their feeding and aboveground activities in the early morning (5:30-9:00 A. M.) and late evening (6-8 P. M.). Prairie dogs were out at all hours of the day but for only a few minutes at a time; then they returned to the comparative coolness of the burrows. On mild days the temperature in the burrow five feet below the surface was 74° F., on the hottest day it was 76° F. at the same level.

During the summers of 1955 and 1956, five dogs died in live traps from the heat, even though the traps were checked every three hours. Overheated prairie dogs foam at the mouth; their faces, throats, and chests become wet with saliva.

In August, 1956, after three days of 108° F. temperatures, fifteen animals in cages in a building died of the heat and ten others were revived by immersing them in buckets of water. These laboratory caged animals were kept in a cement washhouse, shaded by trees, with good ventilation, and were supplied with drinking water.

Light intensity also affects prairie dogs by increasing their activity. The most noticeable effect concerns their entrance into the burrows at night. In winter (January), prairie dogs retire for the night at about 4:00 P. M. In summer (July) they retire around 8:00 P. M. In summer they retire 15 to 30 minutes after sunset; in winter the intensity of the sun's rays begins to wane considerably before it finally sets. As a result, things begin to "cool off" rapidly and the prairie dogs retire about an hour before sunset.

Several times I have released prairie dogs from traps about an hour after sunset (still light enough for me to see clearly) and have watched the prairie dogs groping blindly for the mound and then for the entrance. They not only bump into objects but also fail

to show fright or alarm, and can be picked up or touched without making their usual defensive reactions.

Relations to Associated Animals

As a rule all animals associated with the prairie dog and not considered predators are tolerated or ignored. Meadowlarks, lark buntings, and killdeer were abundant around the pond and in the dogtown, where they nested and secured their food. It was not uncommon to observe 7-8 meadowlarks and 7-8 killdeer feeding in a group of 10-12 prairie dogs. The birds flew back and forth over the prairie dogs, walked all around them and in all my observations were totally ignored by the prairie dogs. Burrowing owls, although not abundant, were present and caused an occasional prairie dog to sit up and watch but never caused an alarm call to be given.

Rabbits, both cottontail and jackrabbit, were abundant. Cottontail rabbits were often observed coming out of prairie dog burrows or crouching just inside. Many were caught in live traps, especially at night. They never caused the alarm bark and now and then were approached by a prairie dog, sniffed and ignored. Neither appeared afraid of the other. Jackrabbits were even more abundant than cottontails and when quietly feeding caused no alarm, but often they would take off on a fast sprint or even a gentle loping gait which caused the prairie dogs to dash for their mounds from which vantage point they watched the jackrabbit disappear. In early morning six to ten jackrabbits would congregate at various seemingly established places near the edges of the dogtown and engage in a sort of play activity; while four to eight rabbits sat in a circle, two others would run around this circle, one following the other by about ten feet, and these two would "take their places" in the circle and two others would take off. All the while guttural sounds would be audible from the group of rabbits. During such activity, prairie dogs would sit on their mounds and watch. This happened two to three times a week in summer and the prairie dogs seemingly always remained curious about it, just as I did.

Three species of lizards, *Holbrookia maculata, Sceloporus undulatus,* and *Phrynosoma cornutum* were present in the dogtown and were found in the burrows as well as above ground. The prairie dogs seemingly paid no attention to them.

Three times the toad *Bufo cognatus* was found in burrows but was never observed out away from the mounds.

By far the most abundant reptile was the ornate box turtle, *Terrapene ornata.* It was not at all unusual to have 6-8 feeding or moving about in the area of blind No. 1 in early morning or late

evening. Mostly the box turtles were ignored by the prairie dogs but on occasion they exhibited considerable curiosity concerning the turtles' actions. As a box turtle would crawl under a cow-chip and start to raise it up so it could be turned over, the prairie dog would sit up and watch until the chip was successfully up-ended and then would return to its feeding.

In one instance a prairie dog was seen to approach a box turtle and make a jump at it as prairie dogs do when they play. Of course the box turtle retreated into its shell, but after a few seconds reappeared and snapped at the prairie dog. This ended the encounter, and the prairie dog went off to feed. Ornate box turtles use prairie dog burrows for refuges and hibernate in them. Mostly old burrows of the slanting type are used, but three or more times in spring, in as many burrows, I have looked into a burrow that went straight down for six to eight feet and with the aid of a flashlight observed an ornate box turtle vainly trying to leave a burrow much too wide for the turtle to climb.

Of snakes, only four individuals were detected in the dogtown in the two and a half years of field study. They were a western hog-nose snake, *Heterodon nasicus;* a massasauga, *Sistrurus catenatus;* a lined snake, *Tropidoclonion lineatum;* and a bull snake, *Pituophis melanoleucus.* Of these only the bull snake could be considered a predator on prairie dogs. Only one individual of the bull snake was ever seen there and it was taken from an abandoned burrow. Indeed, it was in a small area long abandoned by prairie dogs and where considerable numbers of *Perognathus* and *Peromyscus* were trapped.

Thirteen-lined ground squirrels were abundant, and in summer ran in and out of old prairie dog burrows although these squirrels dug their own hibernating burrows. In a few instances prairie dogs seemed to ignore ground squirrels but in most cases the prairie dogs reacted positively to a ground squirrel in sight. Upon seeing the ground squirrel, the prairie dog would utter deep throaty or guttural growls and chase the ground squirrel until it found shelter in a burrow. I never saw a prairie dog catch a ground squirrel and have no information as to what would happen if one were caught.

Onychomys leucogaster, Perognathus hispidus, and *Peromyscus maniculatus* were taken within the dogtown. These inhabit old or little used prairie dog burrows. In winter a prairie dog burrow inhabited by *Onychomys* is readily noticeable because the entrance to the burrow is stuffed with dry grass except for a hole about the size of a half dollar. The reactions of the prairie dog to these

PLATE 1

FIG. 1. Holes dug by prairie dogs in search of roots.

FIG. 2. Prairie dog tracks in snow. Prairie dogs in southern Kansas do not hibernate and in winter remain in their burrows only during storms.

FIG. 1. Remains of four prairie dogs killed by a badger.

FIG. 2. A dome-type mound destroyed and loose soil thrown for 15 feet by a badger that killed four prairie dogs, the remains of which are shown in Fig. 1 above.

FIG. 1. An old dome-type mound, still in use but badly eroded.

FIG. 2. Nose marks, of a prairie dog, in moist soil of a new mound showing how the earth is packed.

FIG. 1. A dome-type mound being constructed from the surrounding soil and grass.

FIG. 2. Adult male prairie dog in autumnal pelage.

animals are not known. Because the grasshopper mice are nocturnal there is probably little occasion for conflict.

Robber flies (Asilidae), Bluebottle flies (Calliphoridae), dung beetles (Scarabaeidae), and darkling beetles (Tenebrionidae) are found in and about the burrow openings. The tenebrionid *Eleodes hispilabris* was especially abundant. In May and early June the hard wing covers of *Eleodes* are found in considerable quantity at the entrances and mounds of the burrows. In only one instance were remains of this beetle found in the stomach contents but the frequency with which the wing covers (elytra) are found on the mounds in spring would indicate that the beetle is eaten at least at that time of year.

Grasshoppers are chased and eaten when captured, but this is a rather infrequent occurrence and they comprise such a small amount of the diet as to be negligible.

Some form of large grazing herbivore is always associated with the prairie dog. As has been stated elsewhere, an overgrazed condition is necessary for the prairie dog to become established in the first place. Bison originally filled the niche later taken over by cattle. Cattle are indirectly responsible for establishment of dogtowns in certain areas of pasture that the cattle select and overgraze. Their frequent presence in the dogtown is generally ignored by the prairie dogs, but the habit that cattle have of pawing dry soil over themselves from the mounds of prairie dogs in order to discourage flies causes considerable excitement and occasionally apparent anger on the part of prairie dogs. This dusting activity also causes the prairie dogs additional work in rebuilding mounds.

The literature (Sperry, 1941:18) shows that coyotes are predators of prairie dogs. Coyotes were never seen in the dogtown in the daytime but observation and identification of tracks in the road that ran through the dogtown showed them to be frequent nocturnal visitors. No burrow was ever dug out in such a manner as to indicate coyote activity. Presence of coyotes in the dogtown at night was probably due to the abundance of rabbits and nocturnal mice. Predation by coyotes in the Barber County area was negligible to non-existent, possibly because my frequent presence in the dog town tended to keep the coyotes away.

In winter both golden eagles, *Aquila chrysaëtos,* and bald eagles, *Haliaeetus leucocephalus,* were occasionally seen at or near the dogtown, but no evidence was obtained of their preying on prairie dogs. Eagles often perched on poles of an electric line that crossed the dogtown, but prairie dogs continued to feed directly below the eagles and nearby without indications of alarm. The abundant

rabbits and ground squirrels probably yielded sufficient food for these birds and took the pressure off prairie dogs as prey. Certainly in some areas and at certain times eagles could be effective predators on prairie dogs.

Hawks always caused alarm and excitement. Reactions to them have been described under the section on communication.

The badger, *Taxidea taxus,* was the only carnivore found to be preying on prairie dogs in Barber County. Although a definite census of the badgers could not be made, a female and two young worked in the area of blind No. 1. This badger family destroyed nine prairie dogs all out of one burrow, in one night. In another instance four prairie dogs were killed and all parts except the heads and fur on the back were consumed in one night presumably by one badger. See plate 2, figs. 1 and 2. Three times prairie dogs left in live traps until late in the evening were killed and eaten by badgers that pulled all but the heads through the mesh of the trap.

Twice, late in evening, a badger was seen chasing a prairie dog. One instance is described under the section on communications. In the other instance the prairie dog successfully eluded the badger by entering a burrow; the badger did not follow but continued across the dogtown. Fresh diggings into prairie dog burrows show up with considerable regularity all through the year and badgers probably destroy a considerable number of prairie dogs in a year's time. Certainly badgers were the most important predators in the Barber County dogtown.

Reactions to Observer

Before I started field work there, the Barber County prairie dog town was used by high school boys for after school "target practice" and on Sundays by certain individuals who looked upon themselves as "varmit hunters." Therefore, at the approach of a car or person, the prairie dogs disappeared down the burrows and remained there for approximately an hour or longer if the cause of the alarm remained. I put up "no hunting" signs, and within two weeks the prairie dogs were so used to my coming and going without harm to them that only the alarm bark from certain individuals resulted from my approach. In walking I could approach to within ten feet of a prairie dog before it would either take to its burrow or run away a few feet. Three individuals developed the habit of "flattening out" in the roadway, and I either had to drive around them or get out of the truck in order to frighten them away.

They seemed not to pay any attention to me while I was in the

blind; nevertheless they did not feed so close to the blind while I was inside as when I was some distance away.

Some prairie dogs trapped for the first time would jump at me with teeth showing and tail bristling, whereas some would crouch in the corner of the trap in apparent fear. Most, when handled for the first time, tried to bite, and when successful they continued to gnash the incisors instead of withdrawing them and biting again. For the record, this author attests to their ability to bite through a finger. When released after marking, prairie dogs would make straight for their own burrows; when about 50 feet away from me they would rub the branded area on the grass in an attempt to rid themselves of the branding fluid. As they occasionally smeared the brands by this activity I usually kept them in the trap a half-hour to three-fourths of an hour after branding to prevent this smearing.

Any prairie dog that was trapped became a repeater. Many had to be released three and four times a day. They sprung the trap, ate all the grain and waited for me to release them, after which they would run off about ten feet and begin to feed on grass. The prairie dogs seemed to show no fear when the trap door shut, but after the grain was gone and they wanted to get out, those being trapped for the first time would claw and bite at the wire mesh of the cage in attempting to escape.

Equipment or other objects left in the dogtown were summarily inspected by the prairie dogs as soon as I was 100 to 150 feet away. They would run toward the object, approach it cautiously in a more or less crouched position with tail bristling and sniff at the object, eventually touch it with their nose and then turn and walk away, paying little or no attention to it thereafter.

MOLT AND PELAGE

At birth, prairie dogs are naked and wrinkled, but fur is present over the whole body by the twentieth day. This fur is fine, soft, and rather sparse. In July and early August young prairie dogs have a post-juvenal molt. This molt starts on the rump and progresses anteriorly; the fur is soft and more sparse than in later pelages. The juveniles undergo also the regular fall molt in early October.

Twenty-three prairie dogs (10 were males) were brought into the animal house at the University of Kansas in the first two weeks in January, 1956, in order to study the molt pattern. Five prairie dogs were dyed black, three red, and two blue; the rest were not dyed. The spring molt begins in the last of April with new fur coming in around the ears, around the eyes, on the nose, and under

the chin. New fur appears on all the toes and on females around the nipples and genitalia, and in males in the midline down the ventral region and spreads outward towards the axillary regions. The area of new fur spreads until areas around the eyes, ears, nose, and chin are all connected; acquisition of new fur continues poste-

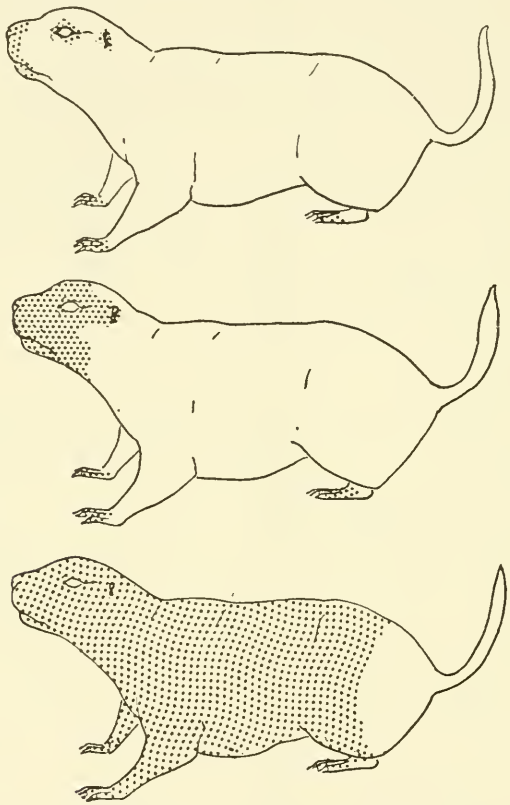

Fig. 2. Molt in an adult prairie dog begins around the ears, eyes, nose and on the toes.

Fig. 3. Area of molt spreads until the isolated areas on the head are connected.

Fig. 4. After the head is covered by new fur, molt proceeds posteriorly. Pelage on the tail molts last.

riorly along the head and neck. A bar of old fur often remains isolated on top of the head for a time, but disappears as the molt proceeds posteriorly. See figs. 2, 3, 4, 5, and 6. The pelage of the tail is the last to change. The autumnal molt occurs in October, and is characterized by a thicker, longer, more buff-colored fur. There is no secondary sexual variation in color of pelage. See plate 4, fig. 2.

Most hairs are black at the base, followed by bands of buff, cinnamon, subterminal buff, and a fine, terminal black tip. Mixed with these hairs are others entirely black, giving the grizzled appearance to the coat. When viewed under the microscope all these hairs are flat instead of cylindrical, their greatest width being at the cinnamon and subterminal buff bands.

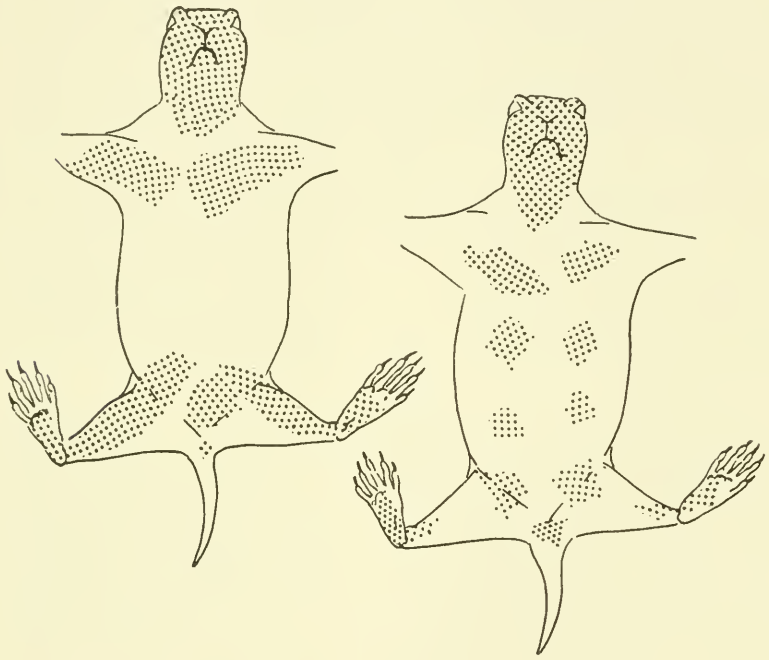

Fig. 5. Ventral molt pattern of adult, male prairie dogs.
Fig. 6. Corresponding stage in ventral molt pattern of adult, female prairie dogs.

REPRODUCTION

The breeding season lasts from two to three weeks. Generally it starts around the last week in January but the time may vary some from year to year depending on the severity of the previous winter and the availability of food.

From March until October the scrotum of the male is not visible and is not pigmented. In October and November the scrotal region is pigmented. Most males caught in mid- and late-January show scrotal testes. The two males having the largest testes were taken on February 4 and 9, 1957. A testis in scrotal position weighs from 3 to 5.5 grams, is 28 to 40 mm. long, and 13 to 16 mm. wide. The

length of a testis in the abdominal position is 10 to 16 mm., and the width 5 to 8 mm.

The length of pregnancy is 28 to 32 days (based on my observations of reproductive organs in prairie dogs that I dissected, and on Anthony and Foreman, 1951). The length of the uterine horn in non-pregnant females is 55 to 85 mm., and the diameter 1 to 3 mm. In pregnant females the uterine horn is from 95 to 135 mm. long, and 3 to 28 mm. in diameter. Embryos may all be in one horn or in any combination between the two horns of the uterus. Although I have never found more than five embryos in the uterus, eight have been reported (Anthony and Foreman, 1951).

The average litter for the Barber County dogtown is four. They are born in late March or April in a helpless condition, devoid of hair, and with eyes closed. They weigh about 16 grams and are 65 to 70 mm. in length. By the 20th day they have hair over the body and at five weeks their eyes open. Small prairie dogs appear above ground when about six weeks old and are weaned probably when seven to eight weeks of age. Most prairie dogs do not breed until two years of age.

BURROWS

Permanent burrows are usually dug in spring or autumn; exploratory burrows two to three feet long are frequently dug in summer. Only one individual digs at a time and may dig the whole burrow by itself or occasionally may be relieved by another prairie dog for awhile. Mounds are constructed or repaired by one individual but more frequently by two or three. Mounds can be constructed only when the soil is moist and workable. See plate 4, fig. 1. After a rain there was great activity in mound building all through the dogtown. Many burrows were constructed at a time when it was not possible to pack the mounds and the loose earth was thrown out in a pile. Before the prairie dog packs the mounds he cleans the burrow. This is done by pushing the debris under himself by means of the forefeet and employing the hind legs in kicking it as far as it will go. Occasionally debris is carried out by means of the forelegs that are folded to push the debris along the ground. Feces and other debris cleaned out of the burrow are incorporated into the mound, as is grass and top soil scraped up from the surrounding area. The prairie dog carries or pushes the soil and debris to the proper place and then on all fours, with body, neck, and head rigid but with the shoulders hunched, forcefully rams its nose into the moist material. See plate 3, fig. 2. Sometimes the head is held slightly down so that the bridge of the nose and the forehead do

most of the packing. One prairie dog may dig out debris while another scrapes up soil and grass from the surrounding area, and yet another does the preliminary packing. Then they all may work at the packing for awhile, with one dog giving the finishing touches to the mound. Both males and females work at constructing mounds. No one individual seems to be responsible for building and repairing a mound. The hot, summer sun bakes this packed mound of mud and grass into a hard, long-lasting structure that even the tire of a car will not dent. See plate 3, fig. 1. Old mounds and piles of soil not yet packed are favored "dusting" places for cattle. Generally prairie dogs do not protest but on occasion they bark excitedly at the cattle and the bolder prairie dogs dash at the intruders and may or may not frighten them away.

Mounds vary from a foot high to three feet high depending on age of the burrow and its location. They are from three to ten feet in diameter.

Although most persons think of prairie dog mounds as being a dome with a burrow plunging down 15 feet or so, such structures rarely exist in Barber County. Lack of moisture over a number of years may have prevented the prairie dogs from constructing crater type mounds. However that may be, ninety per cent of the mounds are composed of loose soil kicked out of the burrow with no attempt to pack or shape it. Only 50 burrows out of 3,172 went straight down six feet or more; most angled off at about a fifteen to twenty-five degree slope. In the 115-acre dogtown there were 6,344 burrows. The area observed from blind No. 1 contained 78,000 square feet (1.797 acres) and 35 burrows in 1955, and 45 burrows in 1956. The area observed from blind No. 2 contained 266,400 square feet (6.1 acres) and had 125 burrows in 1955, and 153 burrows in 1956.

Burrows tend to have their openings in the direction of downward slope. For example, on an east-facing slope 351 burrows opened toward the east, 123 were toward the north, 132 toward the south, and 61 toward the west, 12 being classed as vertical burrows. On the level (less than five degree slope), burrows opened in directions as follows: 220 toward the north, 189 toward the east, 182 toward the south, 190 toward the west, and 13 were classed as vertical.

Burrows that extend straight down six or more feet have rim type craters, burrows which have a sharp incline have dome type craters, and burrows on the fifteen to twenty degree slope have piles of earth showing little or no attempt at construction of permanent

mounds. The prairie dog first excavates a sloping burrow. If he constructs a vertical burrow it is dug from the bottom, the loose earth being kicked out of the horizontal passage. The sloping burrow may then be sealed off or retained as an additional opening to the main burrow.

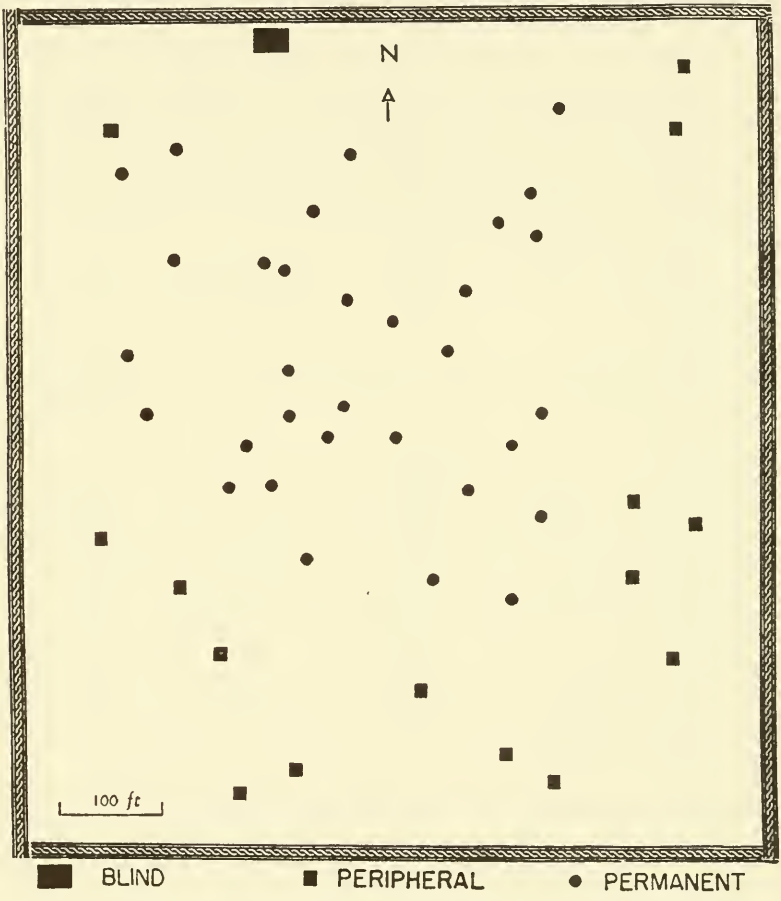

Fig. 7. Map of burrows in the area of Blind No. 1 in NW ¼ of SE ¼ of Sec. 22, R. 10 W, T. 31 S.

Many burrow entrances are sealed. Months later they may be reopened. Introduction of dead prairie dogs into burrows resulted in the burrow openings being sealed within a few hours. This evidently is a sanitary measure; it seems that if the dead cannot be walled off in a lateral passage, the whole burrow is plugged.

Burrows vary so much according to soil type, terrain, and climate,

that to describe a "typical" burrow is to describe something which does not exist. In the past, authors have described burrows fifteen feet deep, some with 36 feet of branching tunnels. Although I did not make extensive excavations, most burrows were five to eight feet deep and had approximately fourteen feet of lateral tunnel. A wide chamber sometimes exists about three feet from the opening of the burrow, presumably for shelter and as a place in which the prairie dog can turn around in order to go back to the mound to look at the intruder after the initial plunge down the burrow. This chamber is also a resting place from which the prairie dog can bark and scold after retreating from the mound. Although I never dug far enough to uncover a nest, other investigators have reported underground chambers lined with buffalo grass (Scheffer, 1947:403).

Certain main burrows were permanent features year after year, but most of them were not that permanent, especially at the periphery of the dogtown. In early June, 1955, six burrows were in use in the area of blind No. 1, and twenty-four other burrows, many of them being peripheral, were present in the area. By mid-June, the twenty-three prairie dogs that had occupied the six burrows had moved out into the previously mentioned peripheral burrows, and had dug eight new peripheral burrows so that by August, 1955, thirty-two burrows were present. In April, 1956, the marginal six burrows again housed all the prairie dogs. By August, 1956, forty-five peripheral burrows were present. Sometime after October, 1956, these forty-five burrows were abandoned for the winter, and in April, 1957, all the prairie dogs in this area again were in the six burrows mentioned previously. See fig. 7.

POPULATION CHANGES

In August, 1955, the 115-acre dogtown had an average of twenty-seven prairie dogs per acre, or a total of more than 3,000 prairie dogs in the dogtown. In August, 1956, this increased to between 3,500 and 4,000 prairie dogs. In April, 1957, the population estimate was at twenty prairie dogs per acre, or a total of 2,300. The effect of drought and predation by badgers, already described, probably accounted for this seasonal drop.

By January, the composition by age is roughly ⅓ juveniles, ⅓ yearlings, and ⅓ adults. Only a few juveniles breed. In prairie dogs trapped alive the ratio of adult females to adult males was 59.41 per 100 individuals, and in yearlings 62 females to 38 males per 100 individuals. The total number of adults trapped was 208 (123

females and 85 males) and of yearlings 146 (92 females and 56 males). I could not positively sex live juveniles. Seven juvenal males and five juvenal females were dissected, but of course this gives little information concerning ratios in the field.

In 1951, Thane S. Robinson of the State Biological Survey measured the length and breadth of the dogtown by means of an automobile speedometer. He calculated the area of the dogtown at 90 acres. By 1955, it had expanded to 115 acres, most of its expansion having taken place on the north and south. Expansion was slow. As observed by me it occurs in the following described manner. Prairie dogs push out into the peripheral areas early in spring while the grass is still short, and many burrows are dug but these are neither deep nor long. These peripheral areas are inhabited all summer and in early autumn, unless the prairie dogs are unable to keep the vegetation cut, in which event the area is abandoned. In either event winter is spent in burrows in the non-peripheral area, and in the succeeding spring attempts are again made to move into the peripheral areas; if the attempts are successful, permanent burrows are established there in early autumn and the individuals involved winter there, thus expanding the area of the colony.

In August, 1956, a forty-acre dogtown one mile from the main buildings of the Hawkins Ranch had spread from a west-facing slope across a 200-foot flood plain, with a creek three to four feet wide and one foot deep, to an overgrazed twenty acres on the opposite east-facing slope. There were no burrows on the flood plain. This might be called expansion or migration. On June 17, 1956, Mr. Alvin Lampe, southwest of Nashville, Kansas, reported two prairie dogs having moved into an overgrazed pasture across the road from his house. Investigation that same day revealed that fourteen burrows had been dug over a three-fourths acre area, but that only two were entensive, the others perhaps being "trial" burrows. The two prairie dogs were not caught until the first week in July and proved to be male and female yearlings. The nearest dogtown was one mile away. During this period (late June-July) I was kept busy checking reports by persons who told of seeing a prairie dog (sometimes two prairie dogs) "along the road." These occurrences were always within a five mile radius of an established dogtown. I was never able to locate these "traveling" prairie dogs nor did reports of new dogtowns come to me except for the one reported above.

In the literature the only reference that I find on mass migration is Seton's (1929; 4(1):278) statement that "Once in a while, for

reasons not set forth by anyone or understood, and yet most obviously satisfactory, the whole population of a dog-town has been known to get up some fine day, forsake home, household effects, land and native ridge, then emigrate to parts unknown, some miles away." Professor Ronald L. McGregor of the Department of Botany at the University of Kansas tells me that he witnessed a mass migration of thousands of prairie dogs. They paid no attention to him or his horse and swept around him in such numbers that he was able to club many of them with a fence post. This occurred in Smith County, Kansas, and Webster County, Nebraska, near the culmination of a severe drought in the late afternoon in late July or early August of 1936.

As to the effects of predation and mortality I can give no reliable figures. Prairie dogs as pets have been reported to live eight years. The first year of life undoubtedly has the highest mortality rate. Young prairie dogs are less wary than those that are older and are of a size more easily taken by more kinds of predators.

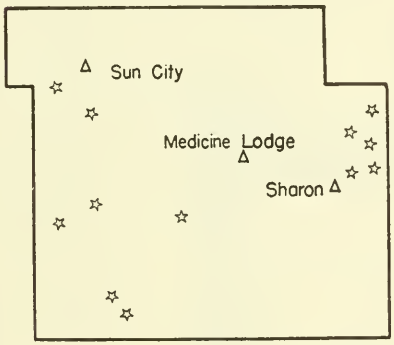

Fig. 8. Outline of Barber County showing prairie dog towns, each colony represented by a star.

Twelve prairie dog towns are known in Barber County. Each of eight of these is no more than twenty acres in extent. Seven prairie dog towns, each of forty acres or more, have been completely poisoned out in the ten years previous to 1955. See fig. 8.

In 1956, questionnaires were sent to twenty-two county agents in the western part of Kansas reported by a rodent control agent to have prairie dogs. The agents reported the total number of acres inhabited by prairie dogs in Kansas to be 42,325 acres of which 17,272 acres were to be poisoned in 1956-57. In a few instances I felt the estimated acreages in certain counties were much too small, but assuming that the twenty-three counties in the western part of the state not reporting prairie dogs each had at least 640 acres inhabited by them, the total acreage in Kansas occupied by prairie dog towns in 1956, would be 57,045 acres, or much less than one-thirtieth of the two to two-and-a-half million acres reported for Kansas by Lantz in 1903. See fig. 9.

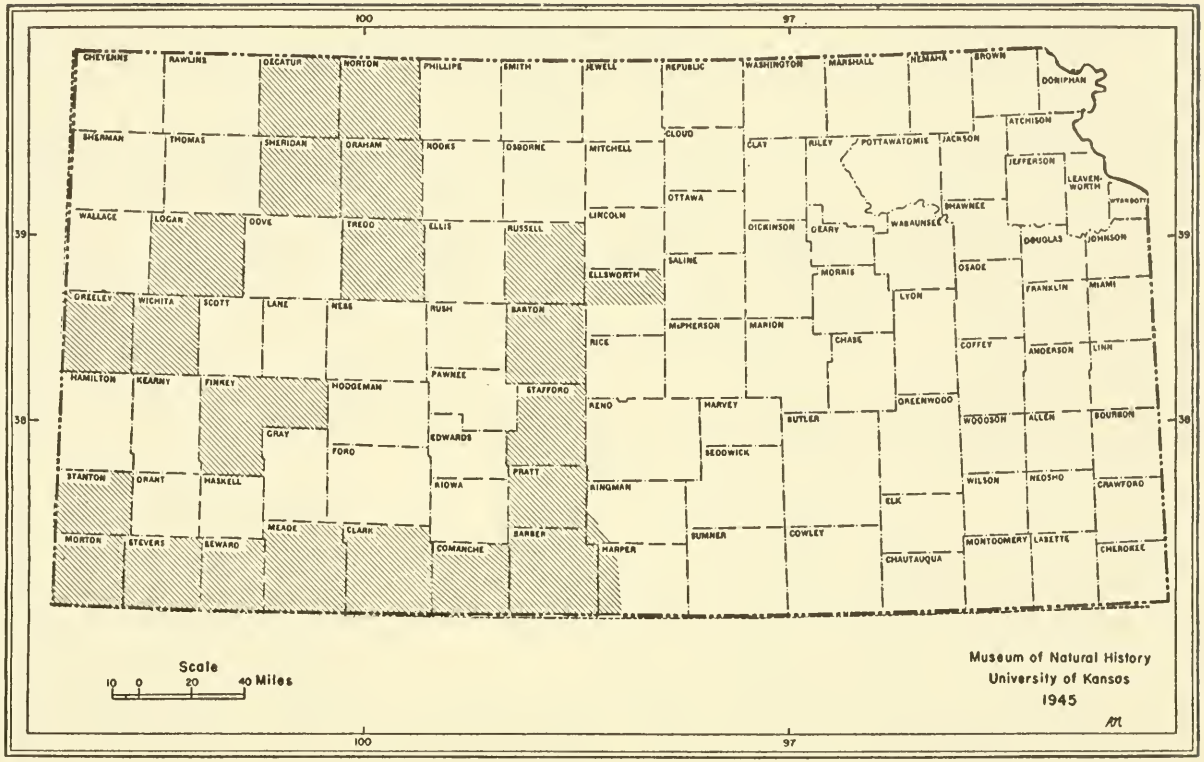

FIG. 9. Shading shows counties in Kansas in which prairie dogs lived in 1956. Detailed knowledge permits showing limited areas in Ellsworth, Harper, and Kingman counties.

SUMMARY

1. Prairie dogs were studied from June of 1955 to June of 1957 in Barber County in one of the last large (115 acres) prairie dog towns in Kansas by means of observation and live trapping, supplemented by laboratory investigations.
2. Prairie dogs in Kansas inhabit the dry, upland pastures west of the 98th meridian. Only the species *Cynomys ludovicianus* (subspecies *ludovicianus*) is found in Kansas.
3. Prairie dogs are diurnal and in summer spend one-third of the daylight hours feeding; one-third playing, working on mounds and burrows, and responding to alarm calls; and one-third, presumably resting, in the burrow.
4. Prairie dogs are gregarious. No social hierarchy was detected. Territories exist but there is no aggressive action in defense of the territory so long as there is adequate food and/or room for expansion of the colony.
5. Communication within the dogtown consists of the alarm bark, the predatory bark, the "all clear" call, a snarl, tooth chattering, and a fear scream.
6. Intraspecific contacts among prairie dogs are on the whole friendly and include mouth contacts, anal recognition, huddling, grooming, and feeding.
7. Grass is the principal food of prairie dogs, but twenty-three per cent of their food is vegetation not eaten by livestock. Therefore, under ordinary conditions they exert a beneficial influence on the range by their preferential food habits.
8. In summer, prairie dogs are up at sunrise; the heaviest concentration of feeding activity occurs from 7 to 11 A. M. and 5 to 8 P. M. They retire to their burrows within thirty minutes after sunset. In winter, prairie dogs may not come above ground before 10 A. M. and retire by 4 P. M. Most of the above-ground activity in winter is concerned with feeding.
9. In feeding, the prairie dog cuts vegetation at its base, and holding the food in one paw eats from the basal portion distally. In this way spiny plants can be eaten without injury.
10. Changes in humidity (short of actual precipitation), in wind velocity, or in barometric pressure seem not appreciably to influence prairie dog activity. However, temperatures below freezing restrict their activity as do temperatures higher than 100° F. Light intensity influences their activity, and in the

absence of sufficient intensity they seem to be blind; they bump into objects and fail to show fright or alarm.

11. As a rule, animals that do not prey on the prairie dogs, are tolerated and ignored. The one exception is the thirteen-lined ground squirrel; its presence evokes throaty growls and aggressive action in the form of a chase from the prairie dog.
12. The badger, a carnivore, was the only animal found preying on prairie dogs in Barber County. Hawks and bull snakes may take the young in June and July.
13. Permanent burrows are dug in spring or autumn. The openings tend to be in the direction of downward slope. Certain permanent burrows give an element of stability to the dogtown, as from these, repeated "assaults" are made on the peripheral areas of the dogtown. Burrows vary in depth and length of underground tunnels according to type of soil, and terrain.
14. Mounds vary in height from a foot to three feet, and in width from three feet to ten feet. Ninety per cent of the mounds are loose earth thrown out in a pile. Mounds of the dome type are constructed when the soil is moist, and are packed by forcefully driving the nose into this material. Dome type mounds are formed by scraping up soil and grass from the surrounding area as the burrow itself has been dug from the bottom up.
15. A spring molt occurs in the last of April and begins around the ears, eyes, nose, and under the chin. New fur appears on all the toes and on females around the nipples and genitalia, and in males in the midline down the ventral region and spreads outward toward the axillary regions. These areas all become connected and the acquisition of new fur continues posteriorly; the pelage of the tail is the last to change. An autumnal molt occurs in October, and is characterized by a thicker, longer, more buff-colored fur.
16. The breeding season begins around the last of January and lasts for two to three weeks. The gestation period is 30 to 32 days. The average litter is four.
17. The Barber County prairie dog town increased by twenty-five acres in four years and is at least thirty years old.
18. Under unsuitable conditions prairie dogs emigrate (usually in pairs) to more favorable areas, generally within a five mile radius of the old dogtown.
19. Dense vegetation is a limiting factor in the establishment of new dogtowns. Since overgrazing of the range by cattle or

bison is necessary before the prairie dog can successfully establish itself, one of the most successful methods of controlling prairie dogs is to remove the cattle from the range until it has had a chance to recover. Prairie dogs are the "result" of range depletion by overgrazing by cattle.

20. Because of their gregariousness prairie dogs are easily poisoned and whole towns are thus completely destroyed. In the last 52 years almost 2,442,955 acres of prairie dog towns have been destroyed in Kansas. Less than 57,045 acres of prairie dog towns remain in the state and 20,000 of these acres are scheduled for poisoning by the end of this year (1957).

In 1947, Theo. H. Scheffer wrote: "Man's primaeval claim to dominate all animal life did not contemplate the destruction of a race. . . . All creatures of the wild have had, or still have a certain value to us in the niche they fill. It goes without least argument that these niches must be narrowed as we encroach upon them with our essential occupations of life; but there always has been, always will be space for the survival of the lowly."

To this may I add my plea—that the farmer-rancher think of control of these animals instead of their total destruction. He has a two-fold obligation in this connection to his progeny; 1) leave his land in better condition than when he received it; 2) retain the aesthetic value inherent in the native plants and animals on that land. Proper management of cattle will insure a good cover of grass that is of monetary value to the farmer, will fulfill his obligation to his progeny, and will control numbers of the prairie dog without annihilating the species.

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Addenda

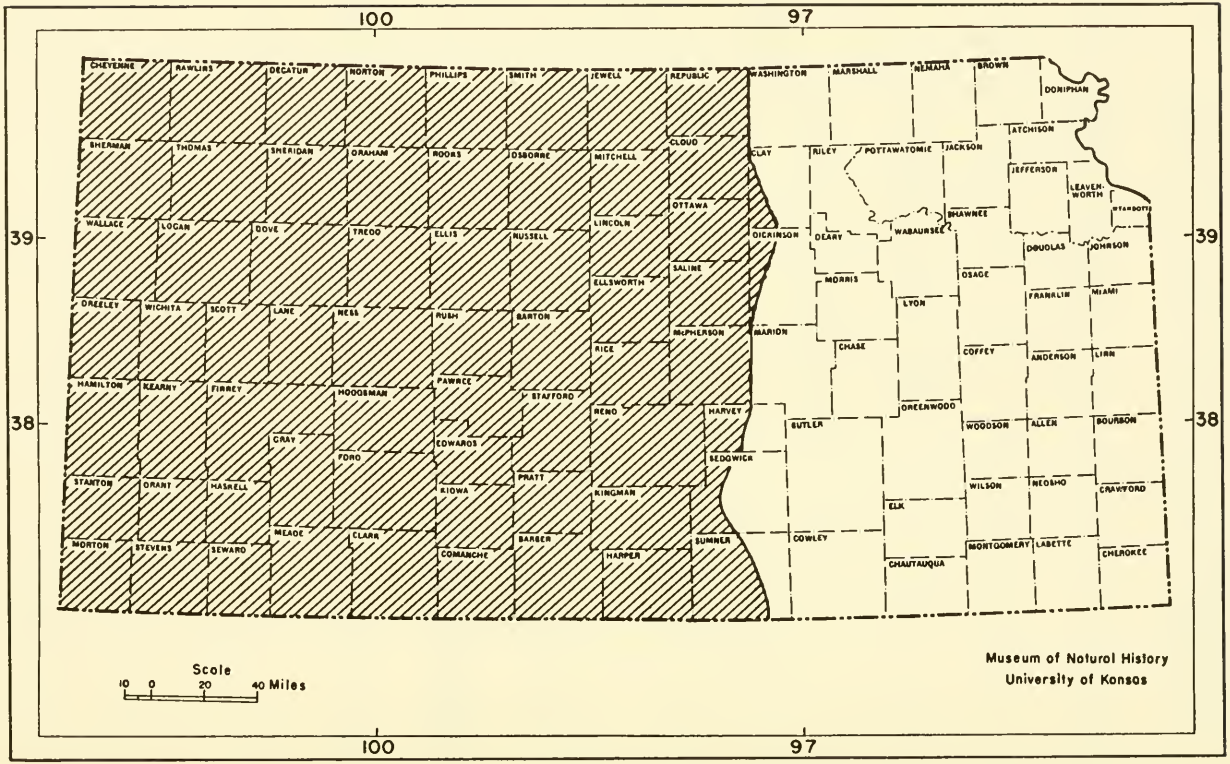


FIG. 10. Shading shows counties in Kansas in which prairie dogs lived in the spring of 1967.

Addenda, in 1967

After this bulletin was printed in 1958, requests for copies exhausted the supply much sooner than was expected. Continuing demand for copies is responsible for reissuance of the bulletin at this time.

Figure 9 on page 32 of the 1958 bulletin showed only counties at that time reported to have at least one town of as much as 40 acres. The shading on Figure 10 on page 38 shows counties reported by county agricultural agents, or as observed by me, to have prairie dog towns in 1967 (irrespective of size). The eastern margin of the geographic range of the prairie dog in Kansas in the spring of 1967 is regarded as accurately shown in Figure 10.

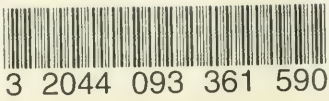
The dog town of 115 acres in Barber county described in detail in this publication was revisited on April 8 and 9, 1967, and studied by Ronald E. Smith along with Stephen R. Wylie. In ten years, the town had expanded eastward 150 feet in a strip about 300 feet long from north to south and the prairie dogs had withdrawn from an area of corresponding size on the northwestern part of the dog town. The total area of the town is about the same in 1967 as it was 10 years before but the number of prairie dogs was fewer—about 1,408 instead of about 2,300 in 1957. In early June after the young are in evidence the population would be about 3,408 in 1967 instead of about 4,000 as it was in 1957. The area is reported to have been heavily grazed every year since 1957 but seems to have been less heavily grazed in the three or four years just passed than in the preceding six or seven years.

For a few years after this publication was issued, efforts to decrease the numbers of prairie dogs may have declined, and their numbers may have increased. Many ranchers now are attempting to reduce or extirpate prairie dogs from their lands.

Where artificial reduction in size of a prairie dog town by means of toxicants is undertaken, the Kansas State University rodent control expert in 1967 recommends the use of chlorofume. It is outstandingly effective when used according to directions but like any toxic gas has the disadvantage of killing all animal life in the burrows treated.

After examining my data on numbers and distribution of prairie dogs in Kansas in 1967, Professor Ronald E. Smith (*in Litt.*) observes: "Ten years ago my Cassandra-like prophecy for these animals was most pessimistic. Now I see a ray of hope, not that these animals will increase in number, but at least for the survival of the small population that is left. The willingness of farmers and ranchers to recognize the dangerous plight of these animals, to recognize that their presence is not the cause but only the result of overgrazing, to recognize that effective control lies in good ranching practices and not in mass poisoning programs, and their attitude of protecting our dwindling wildlife and its habitat for future generations give me hope and confidence in the survival of the prairie dog."—*Stephen R. Wylie.*

Transmitted June 9, 1967.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